

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
30 October 2003 (30.10.2003)

PCT

(10) International Publication Number  
**WO 03/090245 A1**

(51) International Patent Classification<sup>7</sup>: **H01J 17/30**

(21) International Application Number: PCT/US03/07015

(22) International Filing Date: 6 March 2003 (06.03.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/373,508 17 April 2002 (17.04.2002) US  
10/234,498 3 September 2002 (03.09.2002) US  
60/362,494 6 March 2003 (06.03.2003) US

(71) Applicant (for all designated States except US): **BOREALIS TECHNICAL LIMITED** [US/US]; 23545 NW Skyline Blvd, North Plains, OR 97133-9205 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **TAVKHELIDZE, Avto** [GE/GE]; Suite 3G, Eurolife Building, 1 Corral Road, Gibraltar (GI). **TALIASHVILI, Zaza** [GE/GE]; Suite 3G, Eurolife Building, 1 Corral Road, Gibraltar (GI).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

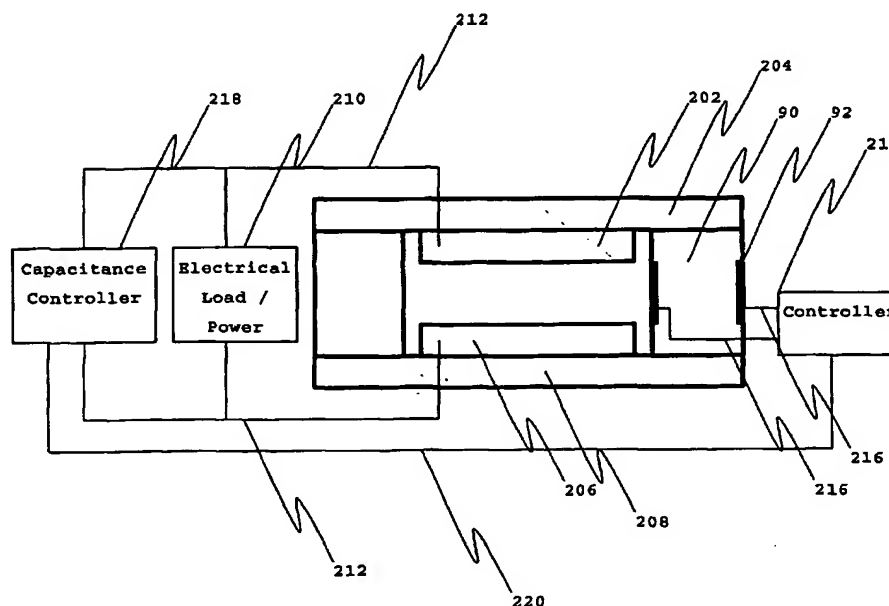
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: THERMIONIC VACUUM DIODE DEVICE WITH ADJUSTABLE ELECTRODES



(57) Abstract: In accordance with one embodiment of the present invention, a Gap Diode is disclosed in which a tubular actuating element serves as both a housing for a pair of electrodes (92) and as a means for controlling the separation between the electrode pair. In a preferred embodiment, the tubular actuating element (90) is a quartz piezo-electric tube. In accordance with another embodiment of the present invention, a Gap Diode is disclosed which is fabricated by micromachining techniques in which the separation of the electrodes (202, 206) is controlled by piezo-electric, electrostrictive or magnetostrictive actuators. Preferred embodiments of Gap Diodes include Cool Chips, Power Chips, and photoelectric converters.

WO 03/090245 A1

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/07015

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H01J 17/30

US CL : 313/602, 603; 362/632

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 313/601, 602, 603

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
USPTO APS EAST

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2001/0046749 A1 (TAVKHELIDZE et al) 29 November 2001 (29.11.2001), see entire document.	1-26

☐

Further documents are listed in the continuation of Box C.

☐

See patent family annex.

\* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

27 June 2003 (27.06.2003)

Date of mailing of the international search report

10 SEP 2003

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

Facsimile No. (703) 305-3230

Authorized officer

GLENN ZIMMERMAN

Telephone No. (703) 308-8991

*Benjamin P. ...*